| Notice of Allowability | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/522,515 | DAVIS, MARK FRANKLIN | |
| | Examiner | Art Unit | |
| | JASON R. KURR | 2614 | |

***-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--***

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *Applicant's Amendment dated November 10, 2008*.

2. ☒ The allowed claim(s) is/are *1,2,5-24 and 33-38*.

3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE**.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☐ CORRECTED DRAWINGS ( as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review ( PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   **Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 11/20/08
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☒ Interview Summary (PTO-413), Paper No./Mail Date *20090218* .
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

**EXAMINER'S AMENDMENT**

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Tom Gallagher on February 18, 2009.

The application has been amended as follows:

**Claim 1:** Line 4 has been changed to: "providing an M:N variable matrix, wherein the matrix is implemented by a digital signal processor,".

The entire claim now reads:

1. (Currently Amended) A process for translating M audio input signals, each associated with a direction, to N audio output signals, each associated with a direction, wherein N is larger than M, M is two or more and N is a positive integer equal to three or more, comprising; providing an M:N variable matrix, wherein the matrix is implemented by a digital signal processor, applying said M audio input signals to said variable matrix, deriving said N audio output signals from said variable matrix, and controlling said variable matrix in response to measures of (1) the relative levels of said input signals, and (2) the cross-correlation of said input signals so that a soundfield generated by said output signals has a compact sound image in the nominal ongoing primary direction of the input signals when the input signals are highly correlated, the image

spreading from compact to broad as the correlation decreases and progressively splitting into multiple compact sound images, each in a direction associated with an input signal, as the correlation continues to decrease to highly uncorrelated, wherein for a measure of cross-correlation of the input signals having values in a first range, bounded by a maximum value and a reference value, the soundfield has a compact sound image when the measure of cross-correlation is said maximum value and has a broadly spread image when the measure of cross-correlation is said reference value, and for a measure of cross-correlation of the input signals having values in a second range, bounded by said reference value and a minimum value, the soundfield has said broadly spread image when the measure of cross-correlation is said reference value and has a plurality of compact sound images, each in a direction associated with an input signal, when the measure of cross correlation is said minimum value.

**Claim 36:** Line 4 has been changed to: "providing an M:N variable matrix, wherein the matrix is implemented by a digital signal processor,".

The entire claim now reads:

36. (Currently Amended) A process for translating M audio input signals, each associated with a direction, to N audio output signals, each associated with a direction, wherein N is larger than M, M is two or more and N is a positive integer equal to three or more, comprising; providing an M:N variable matrix, wherein the matrix is implemented by a digital signal processor, applying said M audio input signals to said variable matrix, deriving said N audio output signals from said variable matrix, and controlling said

variable matrix in response to measures of (1) the relative levels of said input signals, and (2) the cross-correlation of said input signals so that a soundfield generated by said output signals has a compact sound image in the nominal ongoing primary direction of the input signals when the input signals are highly correlated, the image spreading from compact to broad as the correlation decreases and progressively splitting into multiple compact sound images, each in a direction associated with an input signal, as the correlation continues to decrease to highly uncorrelated, wherein a first measure of the cross-correlation of the input signals is in response to a smoothed common energy of the input signals divided by the $M^{th}$ root of the product of the smoothed energy level of each input signal, where M is the number of inputs, and wherein an additional measure of cross-correlation is obtained by applying a measure of the relative levels of the input signals to said first measure of cross-correlation to produce a direction-weighted measure of cross-correlation, and wherein yet an additional measure of cross-correlation of the inputs signals is obtained by applying a scaling factor about equal to a value of a measure of cross-correlation of the input signals for the case of equal energy in each of the outputs.

**Claim 37:** Claim 37 is new.

The new claim reads:

37. (New) Apparatus for translating M audio input signals, each associated with a direction, to N audio output signals, each associated with a direction, wherein N is larger than M, M is two or more and N is a positive integer equal to three or more, comprising;

means for providing an M:N variable matrix, means for applying said M audio input signals to said variable matrix, means for deriving said N audio output signals from said variable matrix, and means for controlling said variable matrix in response to measures of (1) the relative levels of said input signals, and (2) the cross-correlation of said input signals so that a soundfield generated by said output signals has a compact sound image in the nominal ongoing primary direction of the input signals when the input signals are highly correlated, the image spreading from compact to broad as the correlation decreases and progressively splitting into multiple compact sound images, each in a direction associated with an input signal, as the correlation continues to decrease to highly uncorrelated, wherein for a measure of cross-correlation of the input signals having values in a first range, bounded by a maximum value and a reference value, the soundfield has a compact sound image when the measure of cross-correlation is said maximum value and has a broadly spread image when the measure of cross-correlation is said reference value, and for a measure of cross-correlation of the input signals having values in a second range, bounded by said reference value and a minimum value, the soundfield has said broadly spread image when the measure of cross-correlation is said reference value and has a plurality of compact sound images, each in a direction associated with an input signal, when the measure of cross correlation is said minimum value.

**Claim 38:** Claim 38 is new.

The new claim reads:

38. (New) Apparatus for translating M audio input signals, each associated with a direction, to N audio output signals, each associated with a direction, wherein N is larger than M, M is two or more and N is a positive integer equal to three or more, comprising; means for providing an M:N variable matrix, means for applying said M audio input signals to said variable matrix, means for deriving said N audio output signals from said variable matrix, and means for controlling said variable matrix in response to measures of (1) the relative levels of said input signals, and (2) the cross-correlation of said input signals so that a soundfield generated by said output signals has a compact sound image in the nominal ongoing primary direction of the input signals when the input signals are highly correlated, the image spreading from compact to broad as the correlation decreases and progressively splitting into multiple compact sound images, each in a direction associated with an input signal, as the correlation continues to decrease to highly uncorrelated, wherein a first measure of the cross-correlation of the input signals is obtained by means responding to a smoothed common energy of the input signals divided by the $M^{th}$ root of the product of the smoothed energy level of each input signal, where M is the number of inputs, and wherein an additional measure of cross-correlation is obtained by means for applying a measure of the relative levels of the input signals to said first measure of cross-correlation to produce a direction-weighted measure of cross-correlation, and wherein yet an additional measure of cross-correlation of the inputs signals is obtained by means for applying a scaling factor about equal to a value of a measure of cross-correlation of the input signals for the case of equal energy in each of the outputs.

***Allowable Subject Matter***

Claims 1-2, 5-24 and 33-38 are allowed. For the purposes of allowance the numbering of the claims has been changed.

The following is an examiner's statement of reasons for allowance:

The general concept of spatially up-mixing a number of audio input channels through the use of an M:N matrix controlled by the input levels and cross-correlation of the input channels was known in the art at the time of the invention, as evidenced by Irwan et al (US 6,496,584 B2) and Moorer (US 6,072,878). However the Examiner has not found prior art that teaches or suggests the modification of Irwan or Moorer in order to provide a system wherein the measure of the cross-correlation of the input signals is characterized by bounds (i.e. maximum value, reference value) relating to highly correlated to highly uncorrelated, such that the measure of the correlation directly effects the spread of the resultant sound image from compact to broad to a plurality of compact images as disclosed in the independent claims 1 and 36-38. Other prior art has been cited herein regarding audio signal translation , however the other prior art of record also fails to teach or provide suggestion to arrive the combination of the elements and steps presented in the independent claims, again when said elements or steps are collectively considered in regards to each claim. For at least the reasons listed above, the dependent claims are also allowed in view of their respective dependencies upon the independent claims.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably

accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JASON R. KURR whose telephone number is (571)272-0552. The examiner can normally be reached on M-F 10:00am to 6:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Vivian Chin can be reached on (571) 273-7848. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Jason R Kurr/
Examiner, Art Unit 2614

/Vivian Chin/
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